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Biological variation of the raw material and processing conditions affect the yield and quality of fast-marinated herring

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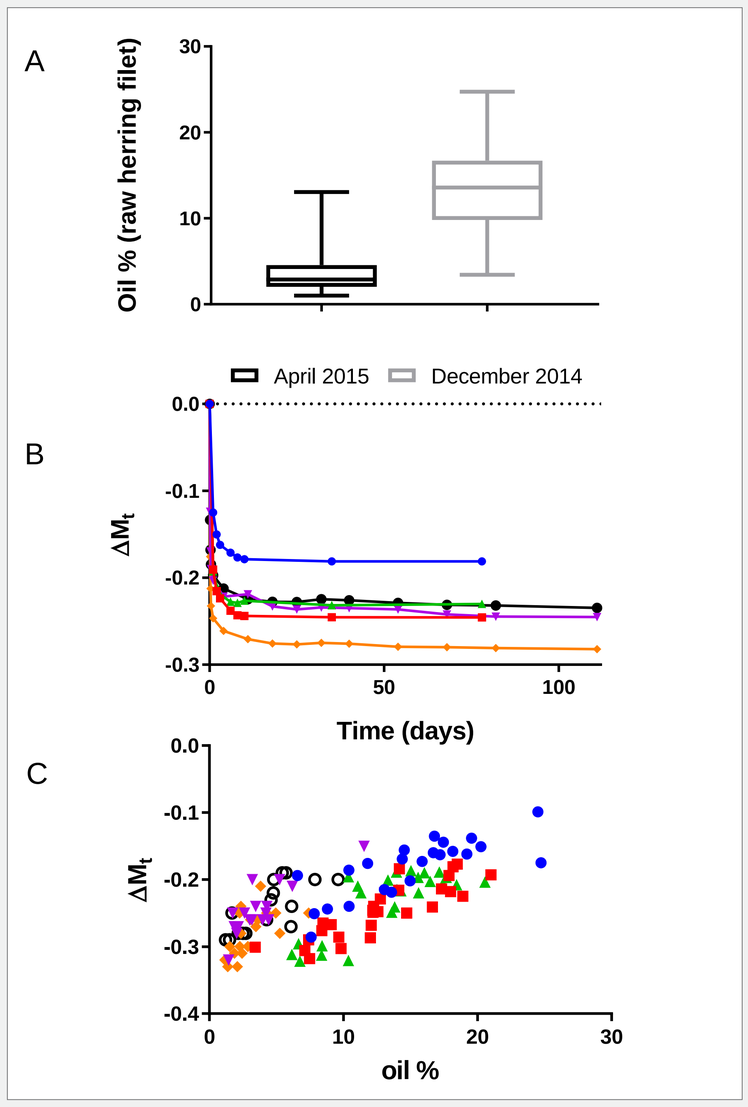
One of the most important factors in a profitable production of fast-marinated herring (*Clupea harengus*) is the yield. The objective of this study is to investigate how the raw material and the different procedures (varying acid and salt concentration) affect the product yield and quality of marinated herring. One of the quality parameters is the amount of protein lost to the brine.

Materials and method

Part 1) Two batches of fresh herring (caught in Dec 2014 and April 2015) were marinated in varying brine concentrations (of NaCl and acetic acid) after pre-brining in 13.3% NaCl for 24 h and the total change in yield were measured on individual level. The oil content of each sample (raw) where measured.

Part 2) NIR spectroscopy (range of 10000-4000cm^{-1}) was measured directly on brine samples from fast-marinated herring filets (80 days). Protein content (based on Kjeldahl Total N content x 6.25) were measured on the corresponding brine samples.



A) The oil content (%) of the raw herring filets (measured on the individual filet) for two batches from Dec 2014 between 3.43-24.74% (n=71) and April 2015 between 1.015-13.06% (n=96).
B) Total mass loss vs. marinating time for each batch using different concentrations of acetic acid and NaCl.
C) The oil content (%) of the raw herring filets vs. the total mass loss after different marinating procedures using different concentrations of acetic acid and NaCl.

Results

Part 1

A great within-batch variation was seen in relation to the oil content of the raw material. It varied between 1.015-13.06% (mean: 3.6%) in April (n=96) and 3.43-24.74% (mean:13.41%) in Dec (n=71) (figure A).

The total weight changes (ΔM_t) calculated by mean of Eq. (1), M_t and $M_\circ$ are the herring filet weight at sampling time *t* and 0, respectively.

$$\Delta Mt = \frac{M_t - M_\circ}{M_\circ} \quad (1)$$

The results showed that the weight decreases with increasing brining time (Figure B). The weight decreases with increasing brine concentration (higher acetic acid concentration). The difference in weight loss observed between the different batches could be explained by the difference in raw material (oil%) from April and Dec. A higher oil% of the raw material results in decreased weight loss, but it is also dependent of the brine concentration (Figure C).

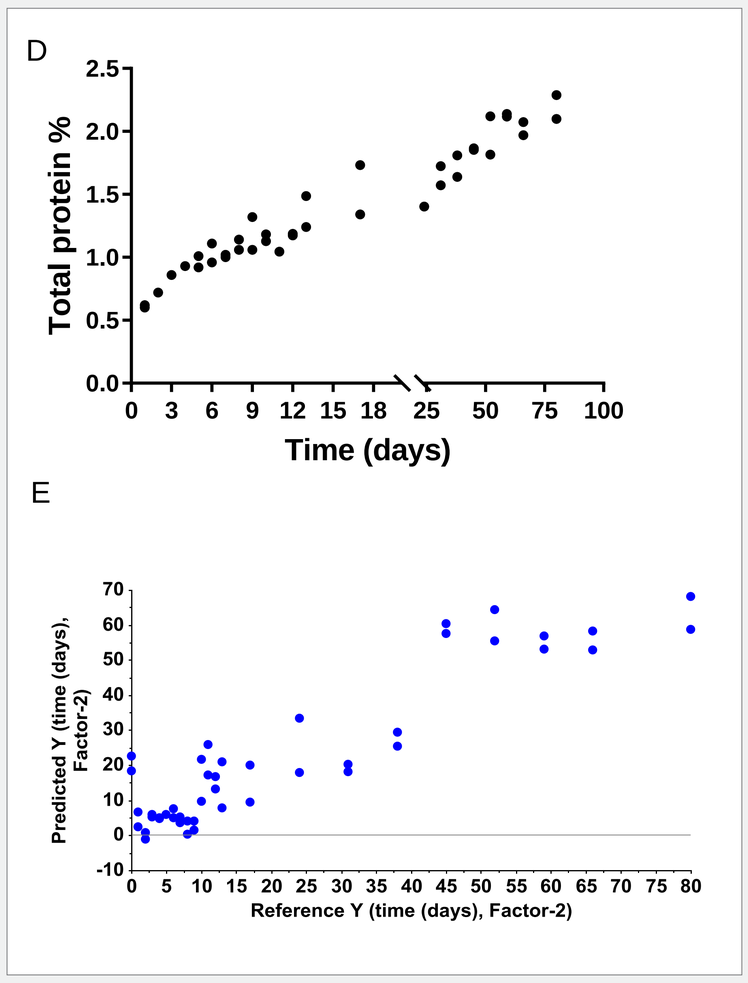
Part 2 Preliminary results

Figure D indicates that a relation between total protein concentration in the brine and the marinating time is found, where the total protein content of the brine increases with time.

A PLS regression performed on the whole NIR spectra of the brine and marinating time, gives a 2 factor model, r is 0.79 and RMSECV is 10 days (explaining 67% of X-variance and 84% of Y-variance). A change in the spectra of the brine with increasing storage time is seen, which could be due to the increasing protein content in brine.

Brine concentrations Figure B and C:

● Dec 3% acid/4.3% NaCl	▼ April 3% acid/4.3% NaCl
■ Dec 6%acid /4.3% NaCl	◆ April 6.5% acid/ 4.3 % NaCl
▲ Dec 9% acid/4.3% NaCl	○ April 4.96% acid/ 5.8% NaCl



D) Measured protein content (in brine) during the marinating procedure of herring filets in acid/salt brine for 80 days (Total Nx6,25) determined by the Kjeldahl method.
E) PLS regression model on the entire NIR spectra of brine and storage time (Pre-processing: first derivative Sav-Gol 2. order, 7 points (left and right), random cross validation.

Conclusion

Both the raw material quality and the marinating procedure (acid and salt concentration) play an important role in relation to the weight change of herring filets during and after the marinating procedure.

A change in NIR spectra of brine samples is observed during the storage time of marinated herring filet. The total protein content in the brine increases with storage time.

Analysis of the spectral data in relation to the measured total protein content will be investigated further in the future.

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